~~SECRET~~

OG-392 A

Rec'd EB 8/8/60
Lorne

COPY No. 1

ANDY
WALT

FILE COPY
EB-18061

HESSE-EASTERN

A DIVISION OF
FLIGHTEX FABRICS INC.
~~CAMBRIDGE, MASS.~~
EVERETT, MASS.

PRODUCT
PROCESS
Engineering

REPORT NO. 7-60-50G-111

MONTHLY PROGRESS REPORT

ENGINEERING PROGRAM FOR
THE PILOT PRODUCTION OF A
LIGHTWEIGHT ANTITANK WEAPON

FOR THE PERIOD

MONTH OF JULY 1960

CONTRACT NO. RD-142

ORDNANCE PROJECT NO.

DEPT. OF ARMY PROJECT NO.

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U. S. C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

~~SECRET~~

HESSE - EASTERN DIVISION

FLIGHTEX FABRICS, INC.

PROGRESS REPORT #3

ENGINEERING PROGRAM FOR THE PILOT PRODUCTION OF A LIGHTWEIGHT ANTITANK ROCKET

JULY 1960

CONTRACT NO. RD-142

PREPARED BY: Thomas H. Forman
Thomas H. Forman
Project Engineer

APPROVED BY: Charles B. Weeks
Charles B. Weeks
General Manager and
Technical Director

SUBMITTED BY: HESSE-EASTERN DIVISION
FLIGHTEX FABRICS, INC.
EVERETT, MASSACHUSETTS

THIS PARTICULAR FUZE THAT BOUNCED MAY OR MAY NOT BE INDICATIVE OF TROUBLE. CONSIDERING THAT ONE OUT OF A TEST LOT OF TEN EXHIBITED THIS TENDENCY; IT COULD WELL BE THAT IT MAY REPRESENT 1 IN 1000 or 1 IN 10,000 OR IT MAY BE 1 IN 10. AN INVESTIGATION IS CERTAINLY IN ORDER. OUR PREVIOUS TESTS PRIOR TO "FREEZING" THE FUZE DESIGN INDICATED THAT THE "BOUNCE" PROBLEM HAD BEEN SOLVED.

WORK ACCOMPLISHED DURING THE MONTH OF JULY 1960

SYSTEM EVALUATION PROGRAM

Production on complete launcher assemblies was started in July with the first batch of 280 launchers delivered to the J-2 Range. The production of the first batch was followed by a short period of evaluation and clean-up of different areas in which better methods appeared to be required. Production was resumed during the last week of the month. It is expected that the flow of launchers can now be kept up until the full quantity has been assembled.

The first batch of 266 HEAT heads was inspected at the subcontractor's premises and found to be acceptable. The heads are presently at the J-2 Range, and pouring operations have started. Some minor difficulties have to be overcome before the production of heads will reach the required rate.

The proof test as mentioned in last month's report was conducted on 22 July. Ten complete systems were assembled and fired at both extremes of temperature. This brought to light the biggest problem yet encountered; one of the ten fuzes failed to arm, and examination showed that it had "bounced." The round containing this fuze was fired at hot temperature. Action was taken to remedy this situation. (See Fuze section of this report.)

Acceptable igniter parts have been received; however, the full quantity is not yet on hand.

The train functioning fixture has been redesigned, and the necessary number of components has been manufactured. Testing will be done very shortly.

FUZE EVALUATION PROGRAM

Since the biggest problem encountered was the fuze, this will be discussed first. As already stated in the introduction to this report, one fuze fired at hot temperature bounced, i.e., the triggering sleeve released the firing pin immediately after the triggering components were set back.

The parts were recovered, and a very thorough investigation was immediately initiated. The only difference, which was soon found, between the R&D lot of fuzes and the fuzes assembled for the pilot production was the supplier of the firing spring. This spring was examined and a comparison made between it and springs left over from the R&D lot. It was found that the new springs are an average of .025" shorter than the old ones. The records from past firings were examined, and it was found that over sixty fuzes had been fired at the hot temperature without malfunction. It must, however, also be pointed out that the last problem during the research and development phase of the fuze was the problem of bounce at the high temperature. The difficulty was solved during the R&D phase by adding to the thickness of the lead at the base of the inertia element. The hardness and composition of the lead washers was examined and compared to the old lot. No significant difference seemed to appear between the two.

In looking at the R&D program it was found that the static test, consisting of dropping the fuze on its base from a height of 35 feet onto a heavy steel base, had been given up, since it was found that fuzes which would bounce when subjected to this test would function properly under all operating conditions in the rocket.

When trying to re-evaluate the fuze design, these facts were all taken into consideration. It was concluded that the R&D lot of fuzes may have been very much nearer to the bounce condition than was formerly believed. The 35 foot drop was re-established in order to come to some better understanding of factors involved in creating this condition.

This work is not as yet complete, but enough evidence appears to be on hand to conduct another firing test. This test will consist of using the same components as before and changing the firing spring only back to the original length. It should be stated here that this change in length was unintentional, and the new and shorter springs had slipped through the numerous careful checks which are being made on all components in order to determine not only whether they are according to print. but also whether the print conforms to the parts as previously used.

The reason for deciding on this test was the fact that some other approaches which were tried and statically tested did not show a sufficient improvement to warrant their incorporation. Every effort will be made to determine at what temperature the fuze will start bouncing, regardless of the final configuration which will be used. It is entirely possible that the change to the longer spring will bring the fuze back into the 100% operating condition. It is not felt that this would be sufficient. The main reason for this is the fact that it is too dangerous to work at an unknown distance from some margin which, if overstepped in some manner, will create conditions under which failures will be experienced.

A number of modifications to the lead backing of the inertia element have been tried in an effort to absorb some of the energy upon setback by deforming material. In order to clarify the situation and to refresh the reader's memory, the bounce condition will be briefly described below before we proceed to describe the modifications which are being tried out at the present time.

A small steel sleeve (triggering sleeve) is used in conjunction with a groove of spherical contour in the firing pin to prevent the firing pin from being pushed into the detonator after the fuze has armed. Prior to firing, this sleeve and the restraining balls and firing pin are in a forward position so as to cause the rotor to be held in the unarmed condition. When the round accelerates, the triggering components, which include the triggering sleeve, are forced back against the base of the fuze. The three restraining balls are housed in a component called the inertia element. This inertia element is the part which makes contact with the base of the fuze. The triggering sleeve is housed in a groove in this inertia element. However, once the triggering sleeve has moved back from the extreme forward position, it is free to move forward, restrained only by the friction created by the pressure of the restraining balls, which are being pushed forward by the firing pin as the firing spring is being compressed. Since the balls are housed in the inertia element in a manner permitting them to move outward only (except for some play in the holes which house them), the force of the firing spring is deflected sideways and acts as friction between the balls and the triggering sleeve. When the components hit the base they are suddenly decelerated. This deceleration is a value which is very much larger than any friction encountered by the components. Since the components cannot move back any further, they all tend to bounce forward again aided by the action of the firing spring, which is now in the compressed state. The inertia element itself is held from continuing forward by the latch spring. However, the triggering sleeve is held only by the friction of the balls. If the "bouncing force" is greater than this friction, the sleeve will move forward. Should it move beyond a certain point, the firing pin will be released and driven into the rotor. The rotor is thus prevented from arming. One more factor has to be considered: if the action described above is completed soon enough, the rocket will still be accelerating, which will prevent the triggering sleeve from moving forward due to "G" loading. This condition does exist in only a very minor degree when the fuze is being dropped on its base against a solid steel base.

When firing at the hot temperature, the acceleration is over in from .008 to .012 seconds. Cold rounds will accelerate from .015 to .020 seconds.

The above should help to show the difference which exists between simulated and actual firing conditions. The following modifications were tried statically:

1) A series of indentations caused by twisting the end. of a small knife after cutting .020" into the lead.

2) A series of center punch marks.

3) Cementing sand particles to the end of the inertia element (on top of the lead).

4) A spacer behind the short firing spring.

5) The fuze as tested 22 July.

6) The fuze as tested 22 July but using the long firing spring.

7) Either spring and annular grooves skived into the lead causing lead rings which have to be deformed.

8) Knife cuts in lead.

The following is a tabulation of the test results:

Fuze Static Drop Test

Drop Height: 35 feet
Base Material: Steel

	Date	Inertia Element	Results
1)	7/22	Knife cuts in lead washer.	Inertia element set back - rotor armed-OK.
2)	"	" " " " "	Inertia element set back - rotor partly armed - bounced.
3)	"	Center punch marks in lead washer.	Inertia element set back - rotor armed-OK.
4)	"	" " " " "	Inertia element set back - firing pin fired back into hole- bounced.
5)	"	Sand particles cemented on lead washer.	Evidence of setback - inertia element did not latch.
6)	"	" " " "	Same as above.
7)	"	Knife blade point twisted in lead washer.	Inertia element set back - rotor armed - OK.
8)	"	" " " " "	Same as above.
9-17)	"	" " " " "	Rotor armed - approx. 12 dimples squashed up - OK.

	Date	Inertia Element	Results
18)	7/22	Knife blade point twisted in lead washer.	Inertia element set back - firing pin fired back into hole - approx. 10 dimples squashed - bounced.
19)	7/25	Knife blade point twisted in lead washer - spacer behind spring.	Bounced? Rotor turned approx. 45°; approx. 15 dimples squashed.
20)	"	Same as 19).	Bounced? Rotor turned approx. 15°; approx. 13 dimples squashed.
21)	"	" " "	OK - Approx. 14 dimples squashed.
22)	"	" " "	OK - Approx. 15 dimples squashed.
23)	"	" " "	OK - Approx. 13 dimples squashed.
24)	"	" " "	OK - Approx. 12 dimples squashed.
25)	"	" " "	OK - Approx. 12 dimples squashed.
26)	"	" " "	OK - Approx. 14 dimples squashed.
27)	"	" " "	OK - Approx. 12 dimples squashed.
28)	"	" " "	OK - Approx. 12 dimples squashed.
29)	"	Heavier spring - lead as is.	Bounced (into same hole).
30-38)	"	" " " " "	OK
39-40)	"	New spring (unplated) -lead as is.	Bounced (into same hole).
41-48)	"	Same as 39-40).	OK
49-64)	"	New spring (unplated) - annular grooves (2) in lead.	OK
65)	"	Same as 49-64).	Bounced - Rotor turned 15°.
66)	"	" " "	Fired.
67-68)	"	" " "	Bounced.
69)	7/26	New spring (unplated) -lead as is.	Bounced.

Hesse-Eastern

	Date	Inertia Element	Results
70-78)	7/26	New spring (unplated) -lead as is.	OK
79-80)	"	Old spring - lead as is.	Bounced.
81-88)	"	Same as 79-80).	OK.

The following is a table summarizing the results:

	OK	Bounced	Partly Armed	Total
Knife cuts only	1		1	2
Center punch	1	1		2
Sand particles				2 (not set back)
Knife blade twisted	2			2
" " "	9	1		10
Knife blade twisted-spacer behind spring	8		2	10
Heavier spring (spacer)	9	1		10
New spring (unplated)	8	2		10
New spring - annular grooves	18	1	1	20
New spring	9	1		10
Old spring	8	2	—	10
	75	9	4	88

As can be seen, there is no very significant difference between the modifications which were dropped in greater numbers. The sand particles may still require investigation, since in this case the sand coating was too heavy and prevented the fuze from latching together.

The results of these static tests were interpreted in the following way:

1) Unless a combination of modifications is found which produces no failures when dropping a test lot of 10 or more, a firing test with the longer spring is indicated. This test should be conducted at a temperature higher than the maximum which will be used in testing samples from the pilot production lot, on the theory that the acceleration will be over sooner on hotter conditions and bounce may therefore occur more readily.

2) Investigation of the problem should continue at the highest priority on the project, and, if possible, a combination of modifications which surpass the present design in reliability should be found. When the test under 1) above has been conducted and static tests with an optimum combination have been carried out, the results of both should be considered before a decision is made to proceed with fuze production.

3) In order to run these tests, some of the components for the pilot production will have to be used up. New components will be ordered as soon as the scope of the tests and the number of additional components, as well as the number of components used up in tests, are known.

Work has started on the possibility of putting a small cushion behind the triggering sleeve in order to minimize bounce. Theoretical evaluation of this possibility has shown that it has great promise. Drop tests (static) will be conducted as soon as feasible.

PILOT PRODUCTION

PROOF TESTING OF TEN PILOT SYSTEMS

The pilot production is now in full swing with all subassemblies being worked on and with propellant loading having been started at the J-2 Range. The loading of the heads is also in the first stage.

Ten complete systems were fired at -20° and +120°F. on 22 July. Some difficulties were encountered in assembling the inner tubes into the launcher tube. For this reason no screws were used to hold the outer and inner tube together. Investigation has shown that this was caused by some oversize inner tubes. These are being centerless ground to the correct size. The drawing has been changed to take care of such a situation. The size of this tube is a stock size, i.e., no machining is being performed on the O.D. or the I.D. The drawing now calls for centerless grinding the O.D. in case it is oversize. No more than .003" can be removed in order not to weaken the wall of the inner tube.

The only other difficulty which is of any significance in this test is the fact that the new launching fixture gave some trouble when firing one of the cold rounds. This condition could be eliminated by having one of the actuating shafts of the fixture run in a bronze bearing. This work has already been carried out, and the fixture should give no further trouble.

The following tabulation shows the results of the proof test. All rounds were fired against a steel target at 50m range and 90^{o} obliquity.

Proof Test

Head: HEAT (Dummy Booster)
Motor: New (Harvey)
Propellant: New Final Lot

7/21/60

Round No.	Description	Temp.	Travel	Trigger Pull Scale	Results
955	Component Functioning (steel plate @50m) (Final)	-20^{o}F	.238	17#	Ignition, flight, and fuze OK.
956	"	-20^{o}F	.230	16½#	" " "
957	"	-20^{o}F	.231	20#	Because of high trigger pull, some trouble pulling off. Tube spit out (no screws & nuts). Fuze OK.
958	"	-20^{o}F	.231	18#	Ignition, flight, and fuze OK.
959	"	-20^{o}F	.234	19½#	" " "
960	"	+120^{o}F	.253	14#	" " "
961	"	+120^{o}F	.241	15#	" " "
962	"	+120^{o}F	.249	14#	" " "
963	"	+120^{o}F	.240	12#	" " "
964	"	+120^{o}F	.240	14#	OK on ignition and flight, but fuze bounced.

As far as the fuze malfunction is concerned, this has already been discussed in the Fuze section of this report. The launcher and motor worked satisfactorily. Dummy boosters were used in order to be able to evaluate the fuze results without danger to personnel. No information is available, therefore, as to the function of the head. However, after conducting the planned train functioning tests and the static test, comparing the new (pilot production lot) to the old (R&D lot) heads, this should not present any great problem.

HEAT AND PRACTICE HEAD PRODUCTION

The first shipment of 266 HEAT heads was inspected by the writer at the manufacturer's plant. The heads were found to be acceptable; fifty heads were checked for critical dimensions and found to be well within limits. The rate at which the supplier is producing these heads, however, is most unsatisfactory. This was strongly pointed out to them, but there is little hope of any improvement. At the present rate, it looks as though the whole order of heads will not be complete before September. This should not necessarily interfere with the production schedule as planned, but it produces some additional difficulties, since it was originally planned to pour and x-ray all the heads and to be done with this work early in the final loading stage. In this way less personnel would be required to assemble the systems.

The practice heads have been completed and are awaiting painting. A new test schedule is being added to the specifications to take care of the fact that that the practice rounds contain no fuzes. The graze test will be eliminated from this schedule, and the rounds thus saved will be used for additional shoulder firing.

FUZE PRODUCTION

Pilot production of the fuze has proceeded satisfactorily as far as the rate of assembling fuzes is concerned. One lot of 250 fuzes has been assembled. No holdup is expected once the present problems have been resolved. However, no more fuzes are being assembled until a decision has been reached as to what course of action to take. (See Fuze section.)

LAUNCHER PRODUCTION

One batch of launchers was completed and sent to the J-2 Range during the month. After carefully evaluating any small problems in production and making some small changes in the procedure, production has been resumed and is currently proceeding smoothly.

A change in procedure which is of importance should be mentioned. This consists in the fact that the checking out and selecting of travel,spacer, etc. in the igniter assembly has been changed in such a way that most of this work, with the exception of loading the black powder, is now going to be done at Everett and not at the range. This will save some costs, since range labor is more expensive than shop labor.

IGNITER PRODUCTION

The supplier of the igniter parts is now setting up to finish the whole order. Some problems have been experienced with this supplier (problems with suppliers seem to be very common these days). The samples submitted early in the month were most satisfactory, but when the first batch of igniter parts was received, it was found in inspecting them that the hole in the cross piece was undersize and that the parts could not be assembled for this reason. Remedial action is being taken, but a considerable delay has been experienced. A sufficient number of igniter samples was on hand to make it possible to conduct the proof tests and to prepare for the forthcoming fuze tests.

MOTOR PRODUCTION

Several hundred motors have been received from Harvey Aluminum. Inspection has shown these motors to be acceptable. Some problems with the hydrotest fixture have temporarily stopped the flow of motors. However, it is expected that motors will be available in sufficient quantities for loading when required.

PACKAGE

The necessary improvements to the canning machine have advanced to the point where a final check-out only is required before it can be sent to the range for installation and use.

DYNAMIC TEST SET-UP

All components have been made and delivered to the test site. The set-up now needs to be assembled and made ready for acceptance tests.

SECRET

Declassified and Approved For Release 2011/11/08 : CIA-RDP78-03642A000800060007-0